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THE CAMBALOID MILLIPEDS OF THE UNITED STATES,
INCLUDING A FAMILY NEW TO THE FAUNA AND
NEW GENERA AND SPECIES

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INTRODUCTION

IT is being recognized that the Pacific Coast States, particularly California, have a larger and more varied milliped fauna than is to be found in any like area of the Eastern United States. Indeed, it is possible that there are not more species of millipeds in the entire region east of the Mississippi River. Because of the more accessible territory and the proximity of interested workers, the millipeds of the Eastern States naturally were subjects of study and, as a group, became fairly well known much earlier than did the western ones. Several of the principal papers on millipeds by Wood, Bollman, and Cook and Collins, while national in scope, nevertheless were based primarily on eastern forms, as these were known in much greater abundance; and to this day the majority of papers on western millipeds have consisted of disconnected descriptions of species with scarcely any attempts at treatment of genera or larger groups, and only one or two lists of species in geographic or political areas have appeared. Such papers give some indications of the numbers of millipeds to be found in the West, but in several recent papers¹ the preponderance of western species has been shown more forcibly in direct comparison with the eastern species, and this preponderance is manifest in the present study and others in preparation.

¹ Cook, O. F., and Loomis, H. F., Millipeds of the order Colobognatha, with descriptions of six new genera and type species, from Arizona and California, Proc. U. S. Nat. Mus., vol. 72, art. 18, pp. 1-26, 1928. Loomis, H. F., New millipeds of the American family Striariidae, Journ. Washington Acad. Sci., vol. 26, pp. 404-409, 1936. Loomis, H. F., Crested millipeds of the family Lystopetalidae in North America, with descriptions of new genera and species, Proc. U. S. Nat. Mus., vol. 84, pp. 97-135, 1937.

The reason for such differences as exist between the number of millipeds of the two sides of the country may be understood from an examination of the environmental requirements of the animals. The limitations that confine groups of creatures to certain sets of conditions vary enormously; some have limitations so lightly drawn that they may inhabit great areas, while others may be restrained from spreading by more rigid requirements. The limitations imposed on the millipeds, and similar humus inhabitants, are especially restrictive, for their movements generally are held to localities having very uniform and constant supplies of food and moisture, or to areas in which they may move about following or keeping within such conditions. A few of the larger millipeds have been able to adapt themselves to semiarid or even arid regions, as the heavily armored, protective covering of their bodies allows greater freedom of movement in the open, above ground, but even these species require some natural protection, and where this is not provided by a humus layer they retreat into deep crevices in the soil or rocks, or into the burrows of other animals, and there spend much of their time. By far the largest number of species are definitely humus inhabitants, delicate creatures, most of them unable to withstand a few moments of hot sunshine or somewhat longer exposure to extreme dryness, whether above or below ground.

Throughout the Eastern States, with their more general rainfall, lower elevation, and abundant deciduous forests, humus conditions occur frequently and over considerable areas, so that intermigration and wide distribution of the humus fauna are possible. In the Western States the rainfall is less uniform; many regions have long seasonal droughts, others are arid deserts; the country is much more mountainous and has higher elevations, and the forests are predominantly coniferous, so that satisfactory humus conditions are generally of smaller extent and more definitely separated than in the East, and examples of isolation and limited distribution among the millipeds are the common rule. While there are many species of restricted distribution in the East, there also are many examples of widespread species, such as *Arctobolus marginatus*, *Polyzonium bvirgatum*, *Spirostrephon lactarium*, and *Polydesmus serratus*, to name but a few. From the literature on millipeds of the West and the collecting that has been done there exceedingly restricted distribution for most of the species is indicated, and none has been found that can be compared to the widely distributed eastern species.

Frequently a few miles separate different but closely related species of western millipeds, and the evidence points to the fauna being chiefly residual, descended in a large number of more or less iso-

lated localities from a common and widespread ancient fauna, as in the eastern region. That the climatic and other changes that separated and restricted different parts of the western fauna occurred very long ago is shown by the many closely related species that have been found, for evolutionary changes sufficient to establish species undoubtedly take places more slowly in animals living under uniform conditions, as do the millipeds, than in animals whose environment is less stable. The relatively large number of generally small but closely related genera among the western millipeds is still better proof of the long isolation that has existed between parts of the fauna, for a still greater length of time is required for the accomplishment of changes of such magnitude as require generic recognition.

The 20 species of millipeds of the suborder Cambaloidea found in the United States are arranged in 12 genera, of which 9 are monotypic and 3 each contain three or four species. Of these 12 genera, 9, containing 11 species, are strictly Californian; another genus of four species has three of them in California and one in Utah; one monotypic genus is confined to Tennessee; and last is the genus *Cambala*, most widely distributed of the American group, with its four species scattered through many of the Eastern States, Texas, and Arkansas. Thus, approximately three-fourths of the members of this suborder are limited to the relatively very small area of California, while all the rest of the United States contributes only one-fourth to the population of the suborder.

The material examined in the preparation of the present paper was collected principally by Dr. O. F. Cook, with a lesser amount collected by the writer and several of his friends. Most of the material plainly belonged to the family Cambalidae, but also included were four species, apparently new, that it has been necessary to refer to the Cambalopsidae, a family associated with India and the Malayan region and hitherto unknown in the Western Hemisphere. The wide removal of the American from the Asiatic branch of this family is, at present, lacking definite proof for explanation, but increased knowledge of the milliped faunas of China, Japan, Siberia, and northwestern North America may indicate past connections, although such evidence may no longer be found except in fossil forms.

Separation of the Cambalopsidae from the older Cambalidae has been made principally on the basis of the species in the former group having an entire or undivided mentum, while the latter group is characterized by species in which the mentum is transversely di-

vided. Whether this difference and several less important and less constant features justify the maintenance of the two families is hardly to be determined from the American material, and for the present the division may be recognized and used without prejudice to simplify classification.

Attems² has tentatively, and apparently mistakenly, transferred several American genera of Cambalidae to the Cambalopsidae, although in no instance does the original description give justification for such a course; in fact, the remarks pertaining to the mentum in these genera usually leave no doubt as to its divided structure and would prohibit removal to the Cambalopsidae.

ORDINAL POSITION OF THE CAMBALIDAE AND CAMBALOPSIDAE

Comparing the Cambalidae and Cambalopsidae with the tropical orders of cylindrical millipeds that have closed segments, the *Anocheta* and *Diplocheta*, we find an association with the latter in the absence of legs on segment 4; the presence of two pairs of legs on segment 5; and the structure of the mouth parts and gonopods. Also the segments of these two families are like those of the *Diplocheta* in being divided by a transverse constriction into anterior and posterior subsegments, while in the *Anocheta* the segments are divided into three belts by two transverse sutures, which often may be seen distinctly, although sometimes scarcely perceptible. The pleural sutures of the *Anocheta* do not appear in the Cambalidae or Cambalopsidae, except that pleural elements may be indicated by oblique ridges that cross the posterior subsegment from the pedigerous lamina to the posterior margin. Hence the Cambalidae and Cambalopsidae have been placed in the *Diplocheta* as a suborder, the Cambaloidea, equivalent to the Spirostreptoidea, which is a very large tropical group.

CHARACTERS OF THE CAMBALOIDEA OF THE UNITED STATES

As has been stated, the most significant difference between the Cambalidae and the Cambalopsidae is whether the mentum is entire or is transversely divided, but inasmuch as the genera of these two families may not be separated readily by other contrasting features it is proposed to examine some of the outstanding characters of the American members of the suborder without regard to family alignment.

The structural characters of the Cambaloidea of the United States are very diverse, and only a few of them are common to all the

² Kükenthal's *Handbuch der Zoologie*, vol. 4, p. 207, 1926.

genera. The other characters are scattered among the genera in a quite indiscriminate manner and do not appear to be associated in regular groups to any great degree. This condition might be observed if only a few of a large number of genera were available for examination, for with additional genera the natural groups might be more clearly shown, as in the reconstruction of a broken prehistoric pot, where many fragments are necessary before a correct conception of the shape and design of the pot may be had. Hence, if a few more genera of this suborder are discovered, it is quite probable that relationships will be better understood, and natural groupings made possible.

With one exception the members of the Cambaloidea are slender creatures, 15 to 20 times as long as broad, but the genus *Choctella* is unique, with its stout body only 10 times as long as broad, quite like *Spirobolus*. In most of the genera a few segments immediately behind segment 1 are constricted and definitely necklike, and this condition is carried to its greatest extreme in *Endere*, in striking contrast with *Platydere*, *Nannolene*, and *Choctella*, which have no noteworthy constriction. Five genera have strong dorsal crests on all but a few segments at each end of the body; three genera have a broad, indefinite swelling on each side of the middle and another at the pore; and in the remaining four genera the segments are uniformly smooth. In *Nannolene* and *Choctella* the pores begin on segment 6 instead of segment 5 as in the other genera, and in *Choctella* the pores are said to be "in front of the transverse suture of the somite." This would locate them in the anterior subsegment and furnish another unique condition for this genus, if it has not been misstated.

Five of the genera are without eyes, while in seven genera eyes are present and composed of from 4 to 40 ocelli, but the presence or lack of eyes is not associated with other characters, such as dorsal crests or swellings, or secondary sexual characters. The antennae of all genera are clavate or subclavate, with the second or third joint usually longest and joint 5 the broadest, although joints 4 and 6 sometimes are its equal. The clypeus has a row of four to six setiferous punctures, except in *Tridere*, where the punctures are much more numerous and scattered over the surface without definite arrangement. The labrum of all genera has three distinct teeth, and the base is crossed by a series of 14 to 16 setae, except in *Tridere*, where there are 20 to 24. The mandibular stipes are recessed for the reception of the antennae in *Odachurus*, *Pharodere*, and *Endere*; in the other genera they are flat or definitely convex.

The last segment is without crests or other surface modifications in all genera except *Tridere*, which has a definite dorsal ridge produced backward behind the valves into a rather blunt, decurved

muco. In most of the genera there are two setae at the apex of the segment, but in *Platydere* and *Leiodere*, at least, the number is increased to four, six, or eight setae. No specimens of *Paiteya* or *Choctella* have been examined, and in the single specimen of *Endere* all setae have been lost.

In all genera the anal valves are without thickened margins, are evenly inflated, meet at a reentrant angle, and each has two setae near the opening. The preanal scale usually is nearly three times as broad as long, and each lateral angle is covered by a small process from beneath the margin of the last segment.

The first pair of male legs of *Paiteya*, *Nannolene*, and *Cambala* are reduced in size and 6-jointed, and the two latter genera lack a claw on the outer joint; instead this joint is short and rounded at tip in *Nannolene*, while in *Cambala* the inner side is deeply excavated from near the base to the apex. In the other genera of which males are known the first male legs are normal as to structure but frequently reduced in size.

The males of *Nannolene*, *Tridere*, *Pharodere*, and *Cambala* have lobes of various types on some of the joints of other legs in front of the gonopods, but in the other genera of which males were examined none of the pregenital legs are lobed.

From the foregoing brief delineation it is seen how inconsistent are the characters among the genera, and the following key to the genera of the family Cambalidae was prepared without attempting a natural arrangement. Diagnostic characters for the recognition of the genera of the family Cambalopsidae are given on page 57.

Family CAMBALIDAE

KEY TO THE GENERA OF CAMBALIDAE IN THE UNITED STATES

I. EYES PRESENT.

1. Body stout, as in *Spirobolus*..... *Choctella* Chamberlin
Body slender, as in *Iulus*..... 2
2. Last segment projecting beyond anal valves in a distinct
muco; clypeal setae scattered..... *Tridere*, new genus
Last segment not mucronate; clypeal setae in a transverse row.. 3
3. Repugnatorial pores beginning on segment 6..... *Nannolene* Bollman
Repugnatorial pores beginning on segment 5..... 4
4. Dorsum with 2 indefinite crests between poriferous promi-
nences..... *Titsona* Chamberlin
Dorsum with 4 distinct crests between poriferous carinae..... 5
5. Eyes with 4 to 8 ocelli in a single series; first pair of male
legs clawless..... *Cambala* Gray
Eyes with 9 or 10 ocelli in 2 or 3 series; first pair of male
legs with claws..... *Paiteya* Chamberlin

II. EYES LACKING.

1. Repugnatorial pores beginning on segment 6; dorsum of segments with a weak longitudinal depression on each side, leaving mesial portion a little elevated.---- **Buwatia** Chamberlin
 Repugnatorial pores beginning on segment 5; dorsum of segments without longitudinal depressions or a median elevation.----- 2
2. Anterior segments not strongly constricted; dorsum without crests----- **Platydere**, new genus
 Anterior segments with sides converging backward, forming a pronounced neck; dorsum with definite crests----- 3
3. Segment 1 with anterior corners flaring outward away from sides of body; lateral carinae and median dorsal crests produced beyond posterior margins of several caudal segments.----- **Odachurus**, new genus
 Segment 1 with anterior corners not flaring away from body; lateral carinae and dorsal crests not produced beyond posterior margin, even on caudal segments.
Pharodere, new genus

TRIDERE, new genus³

Type.—*Tridere chelopa*, new species, from southern California.

Diagnosis.—The strongly mucronate last segment is the most outstanding character, since in no other species in this country does the last segment definitely exceed the anal valves. Also the many scattered setae of the clypeus are unique.

Description.—Body cylindrical, slender, about 16 times as long as broad; head concealed beneath the enlarged first segment; segments 2 to 4 constricted, necklike; last segment mucronate.

Head with the vertex sulcate beneath the first segment, the exposed surface smooth and shining. Clypeus smooth above, with numerous scattered setiferous punctations below. Labrum tridentate and with a transverse row of 20 to 24 fine setae. Mandibular stipes concealed by the first segment, not recessed to accommodate the antennae. Eyes poorly developed and partially covered by the first segment. Antennae (fig. 10, *a*) inserted in widely separated, deep sockets at the sides of the head, each socket bordered by a raised rim on the upper side and by a projecting lateral corner near the eye; antennae moderately clavate; joints 5 and 6 distinctly thicker than the others; joints 2 and 6 of nearly equal length, 3 and 5 somewhat shorter, but longer than joint 4; joint 7 distinctly projecting and with four olfactory cones. Gnathochilarium as shown in figure 10, *b*.

First segment large, concealing much of the head from above, longer than the next three segments together and much broader, with

³The description and remarks pertaining to *Tridere chelopa* were prepared jointly by Dr. O. F. Cook and H. F. Loomis.

lateral expansions carried below the head and mouth parts and much below the ventral line of the adjacent segments; anterior margin straight to below the eyes, then carried forward and downward in a broad, even curve to the rounded posterior corner, the curved margin bordered by a fine raised rim; median surface smooth and shining, lateral surface slightly granular.

Segments 2, 3, and 4 narrowing caudad; segments 2 and 3 smooth above, finely striate low on the sides; segment 4 longer than 2 or 3, with dorsal crests of smaller size but in the same position as those on the ensuing segments, and with a small lateral tubercle in the position of the poriferous carinae.

Succeeding segments gradually broadening, the anterior subsegments considerably exposed, densely and minutely reticulated, the posterior portion constricted and coarsely and regularly fluted in front of the transverse suture; flutings on the lower half of the body usually corresponding to the crests of the posterior subsegment, but the dorsal flutings somewhat more numerous than the crests. Posterior subsegments with about 12 crests between the poriferous carinae; beginning at the middle of the dorsum there is a small crest, then a distinctly larger one, then 3 to 6 smaller crests, which are sometimes quite variable in size and length but are more prominent near the middle of the segment and abruptly lower and narrower behind; the large submedian crests often thickened in front, especially at the anterior end of the body. Lateral carinae with a very large poriferous prominence in front, the carina abruptly interrupted behind it but again raised into a large conic tubercle at the posterior margin. Pores beginning on segment 5 and ending on the antepenultimate segment, opening outward from the smooth oval surface of the pore prominence. Sides below pores with 10 to 12 distinct crests separated by striations; a prominent oblique crest near the legs surrounding a slightly depressed area around the basal joints of the legs.

Posterior segments narrowed gradually, with dorsal and lateral crests reduced; penultimate segment very short, with sculpturing reduced and pores lacking.

Last segment rather long, with an elongate median thickening or ridge continued as a definite mucro beyond the anal valves, surface otherwise smooth.

Anal valves facing obliquely downward, very prominent and inflated, the margins meeting in a deep groove, surface smooth and shining. Preanal scale short and very broad, the posterior margin nearly straight across, somewhat thickened and prominent, with two minute submedian setiferous punctations.

Legs rather long and slender in both sexes, sparsely hirsute; basal joint longer than broad; joint 2 very short; joints 3, 4, and 7 long, subequal; joint 5 slightly shorter; joint 6 still shorter. Pedigerous laminae minutely reticulated, not striate.

Gonopods quite similar in appearance to those in *Cambala*, indicating rather close relationship with that genus.

Segment 6 of the male with the ventral posterior margin behind each leg expanded backward and inward over the gonopods, form-

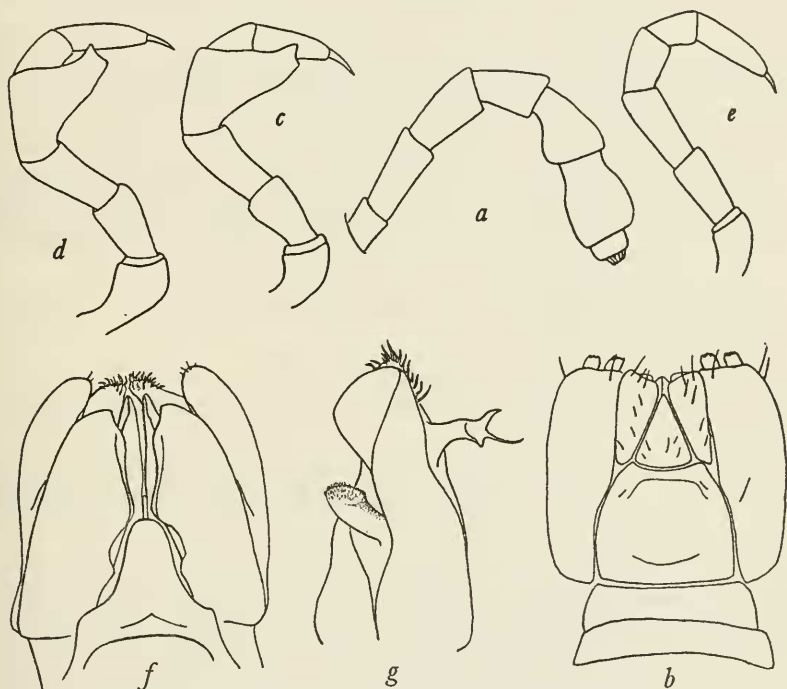


FIGURE 10.—*Tridere chelopa*, new species: a, Antenna; b, gnathochilarium; c, fourth leg of male, posterior view; d, seventh leg of male, posterior view; e, seventh leg of female; f, gonopods of male, anterior view; g, posterior gonopods of male, outer lateral view.

ing two flaplike pieces whose mesial margins lap well beyond each other instead of being in contact along the middle line of the body. In segment 7 the opening through which the gonopods are thrust is broadly rounded behind, the margin raised and thickened, and the median ventral suture is open.

Males with the first three pair of legs somewhat reduced in size; legs 4 to 7 inclusive with joint 5 expanded on the inner-posterior side into a large truncated lobe projecting obliquely distad to near the middle of the last joint (fig. 10, c, d). Leg 7 of female shown in figure 10, e.

TRIDERE CHELOPA, new species

FIGURE 10; PLATE 2, FIGURES 6, 7

Several specimens were collected beside the road from San Diego to El Centro, Calif., about 2 miles above Mountain Springs, on the eastern desert slope of the mountains, December 10, 1922, by Dr. O. F. Cook. The animals were found lying extended under stones on a hillside of decomposing granite rock. Their movements were slow and when first disturbed formed a close double coil. The type is a male, U.S.N.M. no. 1304.

After the original collection was made, the type locality was revisited on several occasions, but no further specimens were found. From the dryness of the locality at that time it seemed a very unlikely place for humus inhabitants, but similar places are known in the desert regions of the Southwest where millipeds and other humus animals follow the soil moisture below ground in times of drought but return to near the surface in seasons when moisture conditions improve.

Description.—Length, 30–40 mm; width, 1.8–2.6 mm. Number of segments, 52 to 58.

Living animals mostly light colored, rather dull pinkish or purplish; head and anterior segments much paler; antennae and legs also pale.

Eyes composed of 10 to 15 rather small ocelli in two rows, forming a transverse, sharply wedge-shaped group, partly hidden beneath the first segment.

First segment with dorsal surface smooth, the lateral surfaces with tiny scattered granules and a few short, fine, striations directed obliquely downward and forward from the posterior margin above the back corner. Last segment appearing smooth, but slight magnification shows a few faint striae and granules; apex of the mucro bearing two setae. Other segments as described under the genus.

Gonopods as shown in figure 10, *f* and *g*.

Genus CAMBALA Gray

Head with eyes in a single series; antennae moderately stout.

First segment about as long as the next two segments together, not expanded on the sides.

Body rather slender, the anterior segments not noticeably constricted to form a neck behind the head and first segment. One to three segments at each end of the body smooth above, the others with four strong crests between the large poriferous carinae. Pores beginning on segment 5.

Last segment not projecting beyond the anal valves.

First pair of male legs 6-jointed and without a claw at tip. The fifth, sixth, and seventh male legs have a large lobe on the ventral side of the fourth joint and sometimes one on the fifth joint also.

KEY TO THE SPECIES OF CAMBALA

1. Body small and slender, not exceeding 20 mm in length and 0.8 mm in width; dorsal crests beginning on segment 4 and ending on antepenultimate segment..... *texana*, new species
Body larger and stouter; crests beginning on segment 2 and ending on penultimate segment..... 2
2. Body of intermediate size, 25 to 38 mm long and 1.2 to 2 mm broad; color light yellowish brown..... *minor* Bollman
Body considerably larger, 44 mm or more in length; color definitely darker brown..... 3
3. Body 18 or 19 times as long as broad; segment 1 with posterior angles produced backward; poriferous keels very strongly developed..... *annulata* (Say)
Body decidedly stouter, 14 to 15 times as long as broad; segment 1 with posterior angles less produced backward; poriferous keels much less prominent; gonopods differing in a number of particulars, as shown in the drawings..... *cristula*, new species

CAMBALA ANNULATA (Say)

FIGURE 11

Julus annulatus SAY, Journ. Acad. Nat. Sci. Philadelphia, vol. 2, p. 103, 1821.

Spirobolus annulatus (Say) WOOD, Trans. Amer. Philos. Soc., vol. 13, p. 212, 1865.

Cambala annulata (Say) COPE, Proc. Amer. Philos. Soc., vol. 11, p. 181, 1869.

Specimens of this species were collected between Roan Mountain and Elizabethton, Tenn., in October 1928 and between Marshall and Hot Springs, N. C., in October 1929 by O. F. Cook. The species has been reported from nearly all the Southeastern States and from Kentucky, but it now seems likely that at least two species, *annulata* and *cristula*, were confused, and the value of these older records must now be shared by these two species, though it is usually not definitely certain to which form specific records apply. The specimens here described and illustrated are believed to represent the typical *annulata* of Say, inasmuch as they are the only ones studied that have the poriferous carinae distinctly "pyriform" as stated in the original description. Bollman reported this species from Indiana and Arkansas, but later he designated the specimens as a subspecies of *annulata* on account of their smaller size and lighter color. It is proposed herein to elevate this subspecies to full specific rank.

The following description has been prepared from the Tennessee and North Carolina specimens to facilitate comparison with the other species of the genus:

Description.—Large but moderately slender animals; 45 to 58 mm long and 2.5 to 3.1 mm broad. The specimens examined had 56 to 65 segments. Some of Bollman's specimens had as few as 50 segments.

Head having eyes composed of four to eight ocelli in a single series paralleling and almost covered by the first segment. Antennae moderately stout; joint 2 the longest; joint 6 the broadest. Clypeus with six setiferous punctures; labrum with 16 smaller ones. Mandibular stipes with the lower half slightly depressed for the reception of the antennae. Gnathochilarium with mentum in two distinct parts, the basal one broader at its apex than the bottom of the upper part.

First segment as long as the three succeeding segments combined and broader than any of the anterior segments; surface smooth; the lateral margin distinctly rimmed; posterior angles slightly produced backward.

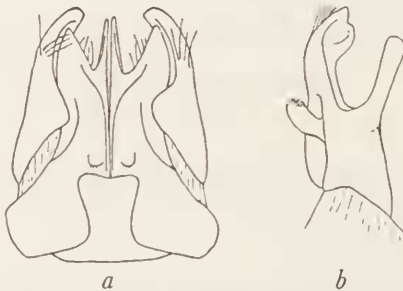


FIGURE 11.—*Cambala annulata* (Say): *a*, Anterior gonopods, anterior view; *b*, posterior gonopods, lateral view.

Behind segment 1 the ensuing segments are considerably narrowed and then increase gradually in breadth to near the middle of the body. Segments 2 and 3 have small distinct crests in the same positions as those on the ensuing segments, the lateral carinae are no longer than the dorsal crests, but on segment 4 the lateral carinae are slightly more prominent than the dorsal crests. Segment 2 has a high, conspicuous ridge on each side just behind the posterior corner of segment 1.

On the succeeding segments there are four very prominent crests between the poriferous carinae, intervals between the crests equal but narrower than the interval between the outer dorsal crest and the adjacent poriferous carina, these latter more prominent than the dorsal crests, the anterior three-fifths thickened and inflated into an ovate process somewhat oblique to the side of the body with the pore near its posterior third; behind the thickened process the carina is abruptly retracted, forming a short, thin ridge about as high as

the dorsal crests. On the anterior segments the pore swellings are conic and oblique to the sides of the body, while on the caudal segments they are lower, more flattened, and nearly parallel with the body. On the penultimate and antepenultimate segments the lateral carinae are no larger than the dorsal crests, but on the next segment in front the differentiation is evident. Below the poriferous carinae are 12 to 14 crests decreasing in size toward the legs, even the upper ones less conspicuous than the dorsal crests.

Last segment smooth, the apex rounded, not exceeding the valves.

Preanal scale large, about half as long as broad; the tab processes at the lateral angles relatively large and conspicuous.

Gonopods as shown in figure 11, *a* and *b*.

First pair of male legs with the last joint bluntly and obliquely truncated on the inner side halfway to the base, the truncation deeply excavated, claws lacking. Legs 4 to 7 inclusive with the outer joint densely hairy beneath; behind the gonopods to the end of the body the five outer joints also are densely hairy beneath, those at rear somewhat less so than those in front. Female legs less hairy. Legs 5 to 7 of the males with the fourth joint bearing a large, hairy-tipped, conic prominence near the distal end on the under side; the fifth joint of these legs sometimes with a similar but smaller lobe.

Segments 6 and 7 of the males with the margin surrounding the genital opening greatly elevated mesially, equaling the top of the first joint of the adjacent legs.

CAMBALA CRISTULA, new species

FIGURE 12

Many specimens collected at Etowah, Tenn. (type locality), November 1, 1929, and a male and a female collected at Adams Run, S. C., October 11, 1929, by Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1305.

This species is closely related to *annulata* but distinguished from it by the stouter body, a female specimen 44 mm long being 3 mm broad; the much less prominent poriferous keels; the smaller produced posterior angles of segment 1; lateral keel on each side of segment 4 no larger than the four dorsal crests, while in *annulata* there usually is a decided contrast; the presence of a lobe on the ventral surface of the fifth joint of legs 5, 6, and 7 of the males, a condition infrequently observed in *annulata*, but like *annulata*, with a large lobe beneath the fourth joint.

The principal difference, however, is found in the structure of the gonopods (fig. 12, *a* and *b*) as a comparison of the drawings of the two species will show.

Leg 1 of the male is shown in figure 12, *c*.

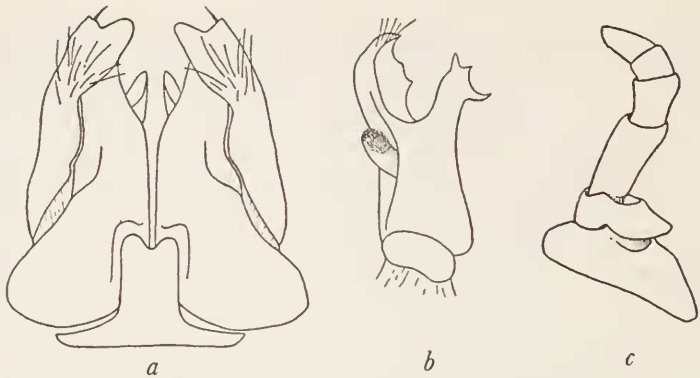


FIGURE 12.—*Cambala cristula*, new species: a, Anterior gonopods, anterior view; b, posterior gonopods, lateral view; c, first leg of male.

CAMBALA MINOR Bollman

Cambala annulata minor BOLLMAN, Proc. U. S. Nat. Mus., vol. 11, p. 404, 1888.
Cambala annulata (Say) WILLIAMS and HEFNER, Ohio State Univ. Bull. No. 18,
 vol. 4, p. 123, illus., 1928.

Specimens of *Cambala* from Little Rock, Ark., and various localities in Indiana were designated by Bollman as representing a new subspecies of *C. annulata* because of lighter coloration and smaller size than specimens from the Southeastern States, whence came Say's specimens of *annulata*. Although Bollman's specimens of *minor* have not been examined, it seems probable that they are the same species as the specimens from Ohio that Williams and Hefner described and figured as *C. annulata*. Comparison of their drawing of the gonopods of the Ohio form with drawings of the gonopods of *annulata*, as interpreted in this paper, shows that two species are involved. If we assume that the Ohio form is the same as that which Bollman had from Indiana, it is necessary to give full specific rank to these forms, using the name Bollman proposed for his subspecies.

Specimens of *annulata* reported by Packard from the Kentucky caves were suspected by Bollman of being either his small subspecies *minor*, or a true and unnamed cave form, and this point still remains unsettled.

CAMBALA TEXANA, new species

FIGURE 13

A large number of specimens were collected at Nacogdoches, Tex., in January 1931 by H. C. McNamara and Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1306.

Diagnosis.—The smaller size of the body, more numerous non-crested segments, the granular crests, and the modifications of the gonopods distinguish this species from the other members of the genus.

Description: Length, up to 20 mm; width, to 0.8 mm. Number of segments, 45-51.

Head with four to seven ocelli in a single series. Mentum narrower than in *annulata*. Mandibulary stipe flattened, with a raised rim along the lower margin.

First segment wider than the head, providing a recess on either side into which the antennae may be bent back; lateral margin bordered by a very fine rim; posterior angles not produced.

Segments 1, 2, and 3 smooth and shining, minutely and sparsely granular. Crests beginning abruptly on segment 4, with four broad crests on the dorsum between the scarcely more prominent poriferous keels, which are represented by oval or subelliptical swellings. On the side of the body below the poriferous keels there are 14 or 15 thinner crests. Surface of the dorsal and lateral crests and the poriferous keels finely but distinctly granular. Dorsal crests sometimes evident on the antepenultimate segment but never on the last two segments.

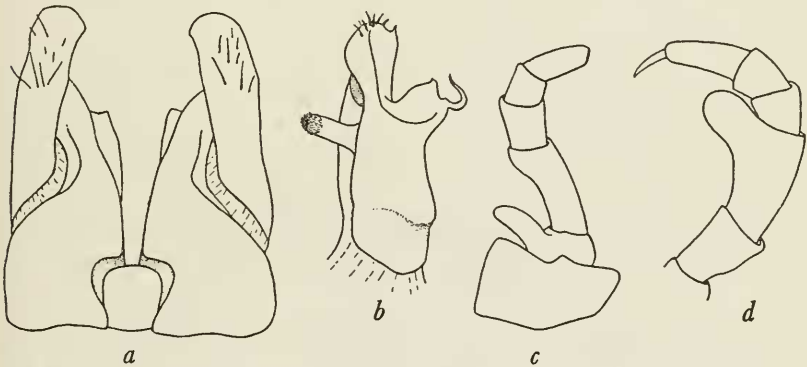


FIGURE 13.—*Cambala texana*, new species: a, Anterior gonopods, anterior view; b, posterior gonopods, lateral view; c, first leg of male; d, outer joints of sixth leg of male.

Last segment relatively longer than in *annulata*, the apex more deflexed and the valves, in lateral view, more oblique. Preanal scale transverse, much less rounded than in *annulata*.

Gonopods and first male legs as shown in figure 13, a-c.

Legs 5, 6, and 7 of the male with a very large process on the ventral side of the fourth joint near its distal end, its apex extending beyond the end of joint 6 (fig. 13, d).

Genus PAITEYA Chamberlin

This genus has some affinity with *Cambala* as shown by the presence of eyes; four dorsal interporiferous crests; first male legs with six joints. The size, however, is much smaller; the eyes are in two

or three rows; the body is "constricted caudad of head, most strongly so over from about fourth to the ninth segments"; the first four and the last three segments are smooth above; the pores are borne "on the enlarged caudal portion of edge of the lateral carina," contrary to the position in *Cambala* and *Tridere*, which have the anterior portion of the carina enlarged and bearing the pore.

PAITEYA ERRANS Chamberlin

Paiteya errans CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 3, p. 258, pl. 43, figs. 4-7, 1910.

This species, which I have not seen, was described without definite locality from southern California. It is 19 mm long, 1.4 mm wide, and has 47-49 segments.

Genus TITSONA Chamberlin

Eyes well developed, five to seven ocelli in a single series. First segment longer than the next three segments together, the sides encircling the sides of the head but well removed, leaving an intervening space into which the antennae may be folded back. Body strongly constricted between segment 1 and segments 5 and 6. First four segments and the last two segments smooth above, the intervening segments with two low, rounded crests near the middle of the dorsum, between the hemispherical pore swellings. In the specific description it is stated that the crests begin on segment 4, but this condition is not shown in the illustration. First male legs reduced in size and 6-jointed, the last joint terminating in a strong claw.

The single species seems more closely related to *Paiteya* than to other known genera.

TITSONA SIMA Chamberlin

Titsona sima CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 5, p. 161, pl. 10, figs. 4-6, 1912.

Known only from the original collection of two specimens at Oroville, Calif. The length is 16 mm; width, 1 mm; number of segments, 42.

Genus NANNOLENE Bollman

Body small, slender, *Iulus*-like; smooth above; anterior segments definitely striate on the sides from the feet to near the pores, the striae receding on the other segments. Segments, except the first four and the anal segment, with a broad, deep transverse constriction around the middle, giving the body a submoniliform appearance, the constriction with a series of rounded pits at bottom.



1, *Pharodere radiata*, female, $\times 7\frac{1}{2}$; 2, *Leiodere dasyura*, male, $\times 8$; 3, *Nannolene violacea*, female, $\times 8$; 4, *Leiodere torreyana*, lateral view of female, $\times 7\frac{1}{2}$; 5, *L. torreyana*, dorsal view of female; 6, *Tridere chelopa*, lateral view of male, $\times 5\frac{1}{4}$; 7, *T. chelopa*, dorsal view of male, $\times 5\frac{1}{4}$.

Head with triangular eyes composed of 12 to 26 ocelli in three to five series. Antennae short and stout with joints 2 and 6 subequal. Clypeus with four setiferous punctures. Mandibulary stipes inflated, not recessed for the reception of the antennae. Gnathochilarium with the mentum in two parts.

First segment long, usually equaling or exceeding in length the next two segments together; anterior angles very broadly rounded and not produced forward; lateral margin with a raised rim; lateral surface with one or more longitudinal striae.

Segments 2 to 4 not narrowed to form a necklike constriction.

Pores beginning on segment 6; each pore surrounded by a flattened rim.

Last segment as long as the two preceding segments together, the apex broadly rounded and with two setae.

Segment 6 of the males with the pleurae overlapping at the middle and produced caudad, partially covering the opening for the gonopods. Anterior margin of segment 7 distinctly raised and thickened around the opening for the gonopods.

First pair of male legs reduced in size, 6-jointed, the apical joint short, rounded-conic, and without a claw.

Sixth and seventh male legs with a hollow conic process on the interior face of the penultimate joint.

KEY TO THE SPECIES OF NANNOLENE IN THE UNITED STATES

1. Size large, 25 mm in length; eyes composed of about 26 ocelli.
 - burkei* (Bollman)
 - Size not exceeding 20 mm; eyes composed of not more than 22 ocelli... 2
2. Body almost white except for a few segments at either end.
 - minor*, new species
 - Body darker, more uniformly pigmented..... 3
3. Length to 20 mm; number of segments to 51; first segment longer than next two together..... *violacea*, new species
 - Size somewhat smaller, number of segments less; first segment shorter than next two segments together..... *uta* (Chamberlin)

NANNOLENE BURKEI (Bollman)

Iulus burkei BOLLMAN, Amer. Nat., vol. 21, p. 82, 1887.

Nannolene burkei BOLLMAN, Ann. New York Acad. Sci., vol. 4, p. 40, 1887.

This species was described from two mature female and two immature male specimens from Ukiah, Calif., and no subsequent localities have been reported. Chamberlin does not state the source of the material from which his drawings were made.⁴

This species is distinguished from our others by the greater number of ocelli—26 in five series; the larger size of the body—25 mm

⁴ Proc. U. S. Nat. Mus., vol. 61, art. 10, pl. 1, figs. 4-10, 1922.

long and 1 mm broad; and the shape of the male genitalia, as shown by Chamberlin's drawing in which the anterior plate and the lateral plate on each side are united instead of two distinct structures as in the other species.

NANNOLENE MINOR, new species

FIGURE 14

Numerous specimens collected near Bakersfield, Calif., December 12, 1927, by Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1307.

Diagnosis.—This species is closely related to *N. burkei* and *N. violacea*. It differs from both species in the smaller body, usually fewer segments, fewer ocelli, and in the structure of the gonopods.

Description.—Body slender, 18 to 20 times as long as broad, moderately moniliform; length, 11 to 16 mm; number of segments, 40 to 47; neck constriction slight, segments 2 to 4 but little narrower than the adjacent segments.

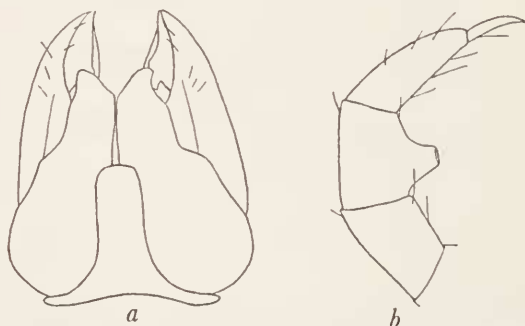


FIGURE 14.—*Nannolene minor*, new species: *a*, Anterior gonopods, anterior view; *b*, three outer joints of leg 7 of male.

Color in life whitish, the extremities of the body darker and very faintly maculate with light violet-brown without definite arrangement. Each side of body with a series of small, dark spots, the repugnatorial glands, showing through the segments.

Head not bent under the first segment; surface distinctly reticulate; vertex with a pronounced median impressed line, from the anterior end of which, on each side, a finer impressed line curves forward and laterad, reaching the upper corner of the eye. Ocelli 12 to 18 in three or four series, forming a subtriangular patch close to the margin of segment 1. Antennal sockets distant from the front corners of segment 1. Clypeus with two large setae on each side. Labrum with three teeth; the base crossed by a series of 16 setae, those on the sides longer than at the middle. Mandibular stipes flush with the sides of the head and the first segment, strongly inflated and with a distinct raised margin and a prominent lower corner; surface coarsely reticulated.

First segment as long as the next two and a half segments together; surface finely reticulated; anterior corners inconspicuous, very broadly rounded but not produced forward; anterior margin straight; lateral margin very weakly rounded, descending obliquely to the posterior corner and with a distinct raised rim; posterior corner sharper than a right angle and clasping the side of the body; lateral striations distinct, four to five, the middle longest, crossing from behind to near the anterior margin.

Segments 2, 3, and 4, viewed from the side, are almost flat along the dorsum, much less convex than the ensuing segments, which have the two divisions strongly separated by a transverse constriction. Lateral striations increasing in height to segment 5, but not reaching the line of the pores; thereafter receding gradually, and on the caudal segments almost entirely confined to the ventral surfaces.

Midbody segments with transverse constrictions very broad, rather shallow, and containing a row of large, irregularly rounded, shallow pits, frequently separated from one another by more than half their width; anterior and posterior subsegments convex, the posterior division more strongly so and with fine, short, impressed longitudinal lines in addition to the tiny reticulations that cover the surface; anterior subsegments more coarsely reticulated. Pores located well behind the transverse constriction near the anterior third of the subsegment; each pore surrounded by a conspicuous, broad, flattened rim.

Last segment as long as the two preceding segments together; margin evenly rounded except for a short distance at the apex, between the two setae, where it is more truncate.

Anal valves projecting behind the last segment; strongly inflated, with margins meeting in a broad deep groove.

Preanal scale a third as long as broad; transversely elliptic; the hind margin more acutely rounded and with a seta on each side of the middle; at each lateral angle a tiny, narrowly elliptic process bearing a seta projects out from under the margin of the last segment.

Male genitalia nearly concealed, the prominent overlapping pleurae of segment 6 produced backward beyond the line of the margin elsewhere and partly covering the opening in segment 7, which is biarcuate behind and has the margin strongly raised and subrevolute.

Male genitalia in two distinct parts. Anterior gonopods (fig. 14, *a*) differing from those of *N. burkei*, as figured by Chamberlin,⁵ by having the ventral plate transverse at base instead of strongly produced downward from the lateral angles; each anterior plate with the apex produced into a short, slightly outward turned lobe,

⁵ Proc. U. S. Nat. Mus., vol. 61, art. 10, pl. 1, figs. 4-10, 1922.

instead of being squarely truncate (the anterior plates in Chamberlin's drawing appear united to the lateral plates); lateral plates more acute at apex, with the upper half of the posterior margin produced inward and forward. Posterior gonopods erect, rather slender, hollowed in front to near the rounded apex from which numerous papillate hairs curve backward; anterior ectal margin with a triangular process directed forward.

Penultimate joint of male legs 6 and 7 with a conical prominence on the inner side larger than in *N. burkei* and with the apex squarely truncate and hollow (fig. 14, *b*)

First male legs similar to those of *burkei* as shown in Chamberlin's drawings previously referred to.

Legs behind the genitalia with a long cavity in the ventral surface of joint 3.

NANNOLENE VIOLACEA, new species

FIGURE 15; PLATE 2, FIGURE 3

Collected by Dr. O. F. Cook in the following California localities: Many specimens of both sexes south of Atascadero, the type locality, January 1, 1928; one female from Tejon Pass, December 14, 1927; one male and many females from Grapevine, below Fort Tejon, February 28, 1929. Two males, lacking one molt of maturity, from Medford, Oreg., June 15, 1937, and a similar male from Chico, Calif., June 24, 1937, collected by L. D. Christenson and L. S. Jones and sent to me by the U. S. Bureau of Entomology and Plant Quarantine, have been identified as this species. The type is a male, U.S.N.M. no. 1308.

Description.—This species is very closely related to *N. minor*, from which it differs most evidently in the following particulars: Body of the same proportion, but sometimes reaching a length of 20 mm; segments as many as 51; ocelli in fully developed specimens in four series containing 18 to 22 ocelli.

Body distinctly pigmented with violaceous-brown, maculate with colorless spots. Head with vertex colored and maculate with many small light spots, which sometimes are confluent; in front of this area the color is unevenly peppered over the surface, becoming lighter toward the front margin of the head; a very large, transverse, oval, colorless area on each side between the antennae; above and slightly mesad of these are two smaller rounded areas. First segment with a very large oval area mottled with light blotches on each side of the fine dark median line; these areas bounded by a solid band of color, broad at the middle of both the front and hind margin and still broader near the hind angles; outside of this band the margins of the segment are colorless and semitransparent, the anterior colorless margin much broader than that behind. Other segments with the

anterior subsegment and the front half of the posterior subsegment colored and finally maculate with tiny light spots and with a series of much larger light spots across the middle of the anterior subsegment and another less distinct series in the constriction; two areas maculate with colorless spots on the anterior subsegments near the legs; the caudal half of the posterior subsegment uncolored and transparent. The series of brown spots on each side of the body is not conspicuous as in the other species, the spots small and partly masked by the other coloring. Last segment with the colored surface very finely peppered with tiny light spots, except immediately behind and under the penultimate segment, where there are numerous large light spots; posterior margin colorless. Valves and preanal scale slightly colored.

Genitalia (fig. 15) showing close relationship to *N. minor*, but the ventral plate shorter and broader; the anterior plates less produced, more acute at tip, more abruptly expanded and wider at base; lateral plates with the rolled margins of the apical lobes less conspicuous from in front, and the lobes of slightly different shape. Posterior gonopods not observed.

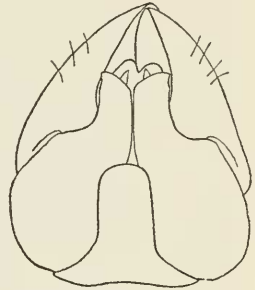


FIGURE 15.—*Nannolene violacea*, new species: Anterior gonopod, anterior view.

NANNOLENE UTA (Chamberlin)

Nemasoma uta CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 5, p. 162, 1912.

Nannole uta CHAMBERLIN, Pan-Pac. Ent., vol. 2, no. 2, p. 61, 1925.

This species was described as a member of the genus *Nemasoma* from a single female specimen found in Little Willow Canyon, Utah, and although the species was again reported from the same locality it was not stated that additional specimens were involved, and it is probable that its inclusion in the paper was for the purpose of re-locating it in the genus *Nannolene*, the designation "*Nannole*," which appeared in this second report, being a typographical error, I have been informed by Prof. Chamberlin.

Because of the variations of size, color pattern, numbers of segments, and ocelli, within the species of this genus, the value of these characters in single specimens is reduced, but the short first segment in *uta* probably is a constant character and should be sufficient to distinguish this species from the other members of the genus in our fauna.

Genus BUWATIA Chamberlin

Head without eyes; antennae subclavate, resting in an excavation extending from the socket to the lower margin of the first segment.

First segment large, embracing the head; with a fine transverse sulcus subparallel to the anterior margin and some distance from it; a second, submedian, sulcus present. Ensuing segments constricted to segment 6. Segments smooth, the dorsum a little depressed, with a weak longitudinal depression each side of middle, leaving mesial portion a little elevated. Since it was stated that the genus is closely related to *Nannolene*, being distinguished from it by the lack of eyes, it is assumed that the pores begin on segment 6. Last segment with a depression in front of the apex. Claws long and slender.

This genus may be intermediate in position between *Nannolene* and *Platydere*, because it is thought that pores begin on segment 6 as in the former genus, and it is without eyes as in the latter genus. From both it differs in having a necklike constriction behind the head, and the dorsum slightly depressed on either side of a slight median elevation. There is but one species.

BUWATIA MONTEREA Chamberlin

Buwatia monterea CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 5, p. 159, pl. 10, fig. 7, 1912.

Described from a single specimen, apparently a female, found at Pacific Grove, Calif. The species has not since been reported.

PLATYDERE, new genus

Type.—*Platydere caeca*, new species, from southern California.

Diagnosis.—Closely related to *Nannolene*, as shown by the smooth segments, the inconspicuous constriction of the neck segments, the row of deep pits in the transverse constriction of the segments, and by the rimmed pores. It differs, however, in being without eyes, in having the first pores on segment 5, and in having four or possibly six apical setae on the last segment, the lateral margin of which is deeply emarginate in front of the processes covering the lateral angles of the scale.

Description.—Body stout, about 16 times as long as broad; with scarcely any constriction of segments 2 to 4 to form a neck; surface appearing very smooth and strongly shining.

Head without a median sulcus or transverse impressed lines as in *Nannolene*; eyes lacking. Antennae inserted on the dorsolateral surface; moderately clavate; joint 2 shorter than joint 3, which is slightly longer than any of the others; joints 4 and 6 subequal, shorter than joint 5, which is the widest joint. Clypeus with sides almost continuous with the labrum but with middle abruptly raised

above it; two setae on each side. Labrum tridentate, with a basal series of setae. Gnathochilarium much as in *Nannolene* but proportionately wider and with upper section of the mentum relatively shorter in relation to the lower section. Mandibulary stipes noticeably convex, not recessed to receive the antennae; with a raised margin.

First segment shorter than the next three segments together; anterior corners more prominent than in *Nannolene* and with the lateral margin much less oblique, with a raised rim reaching around the anterior corner, the sides without striae; posterior corners strongly curved under and clasping the sides of the second segment.

Segments 2, 3, and 4 almost as broad as segments 1 and 5. Segment 4 with the anterior and posterior divisions distinct and separated by a shallow constriction lacking the pits of the succeeding segments; posterior division more convex than the anterior division or than segment 2 or 3. Segment 5 slightly larger than segment 4; the large repugnatorial pore on the anterior fourth of the subsegment surrounded by a broad flattened rim. On segments farther back the pore is located just in front of the middle of the subsegment.

Anterior subsegments near the middle of the body but little less convex than the posterior subsegments and separated from them by a broad and shallow constriction, in the bottom of which is a row of closely placed deep oval pits; posterior subsegments evenly convex from the constriction to the back margin; with many tiny longitudinal impressed lines seldom connected as are those on the segments of *Nannolene*. Lateral striations few and wide-spaced, highest on segments 5 and 6, where they reach halfway to the pores; on the caudal segments they are almost entirely confined to the ventral surfaces. Segments near caudal end of body becoming less convex. Penultimate segment nearly as long as the antepenultimate, almost flat.

Last segment relatively short, not as long as the two preceding segments together; apex subangularly rounded but less produced backward than in *Nannolene*; with three setae on one side of the middle and two on the other side in the type specimen, indicating six setae normally; an additional seta near the middle of the hind margin on each side; margin immediately in front of the large tablike processes very deeply emarginate, exposing much of them.

Valves moderately inflated; margins meeting in a deep groove; each valve with the usual two setae near the opening. Scale relatively long; posterior margin more rounded than the anterior margin and with a pair of widely separated setae.

PLATYDERE CAECA, new species

A single mature male specimen collected with specimens of *Leiodere dasyura* at Tajiguas, Calif., January 1, 1928, by Dr. O. F. Cook. Type: U.S.N.M. no. 1309.

Description.—Body rather stout, 16 mm long and 1 mm wide. Number of segments, 44. Color almost white, with the repugnatorial glands showing through the sides of the body as a series of small orange spots, which turned almost black after the specimen had been stored in alcohol.

Head smooth and shining; surface of the vertex with tiny, very faint, impressed reticulations visible only by cross lighting under moderate magnification; labrum with a series of 14 setae at base.

Segment 1 as long as the next two and a half segments together; the posterior corners strongly curved under and clasping the lateroventral surface of segment 2, not produced backward; entire posterior margin straight; as seen from above, the sides of the segment are almost parallel, being slightly rounded from front to back, the segment widest at the middle or a little way in front of it.

Segments 2, 3, and 4 scarcely constricted, the posterior margin of segment 4 being over seven-eighths the width of segment 1 at its widest part. Segments 2 and 3 not longitudinally convex, flat, when viewed from the side.

Near the middle of the body the exposed portion of the anterior subsegments is very smooth and shining and has a few long, slightly wavy, impressed, longitudinal lines; the covered part of the subsegment has coarse reticulations showing through the transparent posterior subsegment of the preceding segment; posterior subsegments scarcely higher than the anterior subsegments.

Preanal scale about three times as broad as long, the posterior margin rounded.

Genus CHOCTELLA Chamberlin

Body large and stout, only about 10 times as long as broad; dorsal surface smooth; lateral surface strongly striate from the feet to the repugnatorial pores. Eyes composed of many ocelli arranged in five or six rows. Antennae short and stout. Clypeus with six setiferous punctures. First segment extending forward over the head and partly concealing the antennae; anterior angles broadly rounded and distinctly produced forward; lateral margin with a raised rim. Repugnatorial pores large, beginning on segment 6 as in *Nannolene*, but said to be "in front of and well removed from the transverse suture," a statement that is open to question, as in all the other members of the family that the writer has examined the pore is in the posterior subsegment, definitely behind the constrict-

tion. Last segment evenly rounded at apex and exceeded by the anal valves. First pair of male legs reduced in size but otherwise normal. Segment 7 of the males with the margin around the gonopods moderately elevated.

Only one species is known.

CHOCTELLA CUMMINSI Chamberlin

Choctella cumminsi CHAMBERLIN, Psyche, vol. 25, p. 25, 1918.

This species was described from a dozen specimens collected in the Glendale Hills of Tennessee and has not since been reported.

Average length, 50 mm; number of segments, 44 to 48; general color black, the segments apparently with yellowish or reddish markings in front and along the posterior margins. Eyes with 30 to 40 ocelli in five or six series forming a triangular group. Antennae with joints 2 and 3 subequal, longer than the others; joints 5 and 6 broadest. "Coleopods simple, thin plates, each of which is moderately narrowed distad and narrowly rounded at the apex; below apical portion the mesal border of each is bent subcaudad. Phallopods exceeded by the coleopods. Each with distal division narrowly subconical, distally curved mesad, the tip somewhat obliquely truncate."

PHARODERE, new genus

Type.—*Pharodere radiata*, new species, from southern California.

Diagnosis.—This genus and *Odachurus* are the only eyeless members of the family in this country that have well-defined dorsal crests. *Pharodere* differs from *Odachurus* by lacking the flaring anterior corners of segment 1 and the swollen dorsum near the back margin, but there are prominent lateral striae on this segment; and on the caudal segments neither the lateral carinae nor the dorsal crests project as teeth beyond the back margin, and the crests are higher and more abruptly raised than those of *Odachurus*.

Description.—Body slender, about 20 times as long as broad; segments as many as 64.

Head without eyes. Antennae widely separated, inserted on the dorsolateral surface, moderately clavate, the basal joints slender as compared to the outer joints. Clypeus with three setae on each side. Labrum tridentate, somewhat depressed below the clypeus, and with a basal row of setae. Gnathochilarium as shown in figure 16, *a*. Mandibular stipes receding beneath the head, the lower half hollowed to receive the antennae.

First segment not quite so long as the next three segments together, widest near the front corners which are broadly rounded, somewhat produced forward, and with the intervening front margin nearly straight; lateral margin with a raised rim, rounded and very obli-

quely descending to the back corner, which is not quite a right angle and clasps the side of the body; lateral surface striate.

Segments 2, 3, and 4 with the sides gradually converging behind, necklike, the posterior margin of segment 4 only three-fourths as wide as segment 1. Segments 2 and 3 flat, not at all convex, dorsum smooth, the sides with striations. Segment 4 with the anterior subdivision somewhat exposed; the posterior subdivision moderately convex and with crests as on the subsequent segments, but less distinct.

Anterior division of the midbody segments moderately convex; crossed behind by a series of channels nearly twice as long as broad and usually with a large, deep, round or oval pit occupying the back half of each channel; channels separated from each other by a thin raised ridge; in front of the channels the surface is coarsely and distinctly honeycomb-reticulated. Posterior subsegments abruptly elevated from the constriction but with the dorsum flat, not at all convex as seen from the side; between the prominent poriferous carinae are six to eight thin and high longitudinal crests crossing the subsegment, the inner pair conspicuously thicker and higher than the others and more widely separated, the smaller crests number two to four on each side with three the rule. Lateral carinae prominent, abruptly elevated from the sides, greatly thickened in front into a broad, oval area with a rather large depression containing the pore; posterior part of the carina thin, ending in a right angled corner above the posterior edge of the segment. Beginning on segment 5 and for several segments thereafter the pores are borne on broad, rounded elevations rather than on a definite carina. Below the poriferous carinae are 12 to 15 longitudinal striations. Penultimate segment with dorsal crests and lateral carinae almost as strong as those on the foregoing segments.

Last segment smooth and shining, the dorsum scarcely convex in lateral view, not quite so long as the two preceding segments together; posterior margin thickened, especially at the apex, which bears two setae and is narrowly rounded and projects a little beyond the valves but not as a conspicuous mucro. Valves little inflated and with margins meeting in a narrow, shallow groove. Preanal scale almost four times as broad as long, the posterior margin nearly straight; tab processes small.

Segment 6 with the margin around the gonopods scarcely raised but the overlapping pleurae are strongly produced backward, nearly covering the gonopods. Segment 7 with the genital opening semi-circular; the margin not separately raised.

First and second male legs smaller than ensuing legs, with well-developed claws. Sixth and seventh male legs with a process on the inner side of the penultimate joint somewhat similar to that in the same position in *Nannolene*.

PHARODERE RADIATA, new species

FIGURE 16; PLATE 2, FIGURE 1

Several males and numerous females collected with *Odachurus petasatus* and *Leiodere torreyana* under stones on the cliffs near the sea at Torrey Pines, La Jolla, Calif., November 26, 1925, by Dr. O. F. Cook and H. F. Loomis. The type (U.S.N.M. no. 1310) is a male. Other specimens are from the same locality early in 1925 and also from Hodges Lake, Calif.

Description.—Body slender, ranging from 12 to 20 mm in length and from 0.6 to 0.8 mm wide. Number of segments, 43 to 64, the smallest specimen being a male with 43 segments. Living color grayish white.

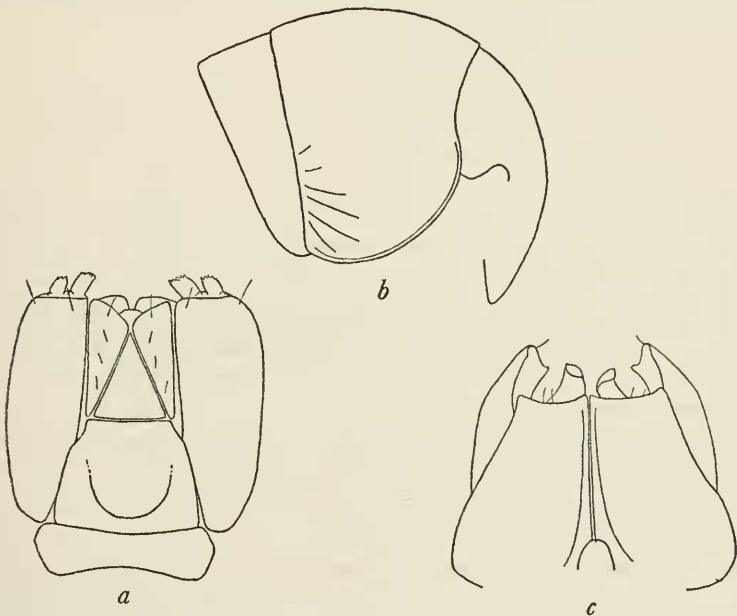


FIGURE 16.—*Pharodere radiata*, new genus and species: *a*, Gnathochilarium, the hypostoma not shown; *b*, head and first two segments, lateral view; *c*, gonopods, anterior view.

Antennae with joint 2 longest; joint 5 next in length and widest of all; joints 3 and 4 subequal in length and shorter than joint 6. Labrum a little depressed below the level of the clypeus, especially at the middle, and with a row of 14 setae across the base. Mandibular stipes large but receding beneath the head, the upper part of each stipe a little convex but the surface above the lower marginal rim distinctly hollowed for the reception of the antennae. Head and first two segments shown in lateral view in figure 16, *b*.

First segment with the posterior margin noticeably emarginate at middle; lateral surface with six striae radiating from a short space

along the posterior margin a little way above each corner, the lower striae about a third as long as the dorsum, the upper ones shorter and pointing obliquely upward; remainder of surface with minute impressed lines forming a very inconspicuous network visible only with rather high magnification.

Segment 2 with a few fine striations low on the sides, the dorsum smooth. Segment 3 also smooth but with the lateral striations extending above the line of the pores of the poriferous segments.

Segments near the back end of the body with the pair of large, inner, dorsal crests and the lateral carinae more elevated than on the median segments and terminating in right-angled corners, but not projecting beyond the posterior margin of the segments. Penultimate segment a little shorter than the foregoing segment and with the crests and carinae almost as strong.

Gonopods as shown in figure 16, *c*.

ODACHURUS, new genus

Type.—*Odachurus petasatus*, new species, from southern California.

Diagnosis.—Closely related to *Pharodere*, with which it was found. It differs in the flaring anterior corners and swollen surface of segment 1, which lacks lateral striations; the less prominent dorsal ridges of the principal body segments, although on several segments preceding the penultimate the inner pair of ridges and the lateral carinae are produced beyond the posterior margin; penultimate segment short and smooth.

Description.—Body the same shape and size as *Pharodere*. Head with the labral and clypeal setae broken off but otherwise not differing notably from *Pharodere*. Gnathochilarium not dissected, but apparently the mentum is in two parts.

First segment with the anterior corners obtusely rounded and inconspicuously produced forward, very distinctly flaring outward away from the sides of the body, when seen from in front or above, and forming the widest part of the segment; side margins very oblique, with a raised marginal rim visible only in front as the posterior half of the margin abruptly rolled under; posterior corners quite sharp and slightly flaring away from the sides of the body instead of clasping it as in other genera; dorsal surface inflated, especially in front of the median part of the posterior margin which is partly hidden from above; lateral surface without striae.

Segments 2, 3, and 4 forming a neck gradually narrowed to the posterior margin of segment 4, which is only three-fourths the width

of the first segment across the anterior corners. Segments 2 and 3 nearly flat longitudinally, without a transverse constriction; lateral striae reaching to the edge of the dorsum on segment 3. Segment 4 with a transverse constriction, the posterior subsegment moderately convex and with ridges arranged as on the ensuing segments but fainter.

From segment 5 to the caudal end of the body the anterior subsegments are as in *Pharodere*, with anterior portion coarsely reticulate, the posterior part longitudinally channeled, each channel containing a rounded pit behind. Posterior subsegments abruptly raised from the transverse constriction, the dorsum a little convex, with ridges disposed as in *Pharodere* but less definite in shape; a large ridge on each side of the middle, the pair widely separated; between each large ridge and the lateral carina are two or three smaller, lower ridges; all ridges arising from the front of the subsegment but not reaching the posterior margin on any but the hindmost segments; posterior margin flat and lower than the surface between the ridges. On several segments immediately preceding the penultimate segment the large median crests increase in size and project beyond the hind margin, the other ridges becoming less evident and not projecting. Pores beginning on segment 5, borne in a very small and shallow depression in the broad margin of the lateral carinae. Lateral carinae of less definite shape than in *Pharodere*, especially on the anterior segments, where they are little more than rounded swellings; on the posterior segments they are more flattened than on segments farther forward, but each is strongly produced beyond the hind margin as a triangular tooth. Below the lateral carinae numerous prominent striae reach to the feet. Penultimate segment very short and without ridges or lateral carinae.

Last segment long; dorsum nearly flat longitudinally; the thickened apex angularly rounded, a little projecting beyond the valves and with two setae.

Anal valves inflated and meeting in a rather broad, deep groove; each valve with two setae near the opening. Preanal scale very short; the hind margin straight across, the front margin broadly rounded; processes small, each with a short seta.

ODACHURUS PETASATUS, new species

FIGURE 17

A single mature female specimen collected with specimens of *Pharodere* and *Leiodere* beneath stones on the cliffs above the sea

at Torrey Pines, La Jolla, Calif., November 26, 1925, by Dr. O. F. Cook and H. F. Loomis. Type: U.S.N.M. no 1311.

Description.—Body about 14 mm long and 0.7 mm broad. Number of segments, 51. Color in life whitish gray.

Head and first segments shown in figure 17, *a* and *b*.

Segment 1 has the posterior edge distinctly emarginate medianly, but the pronounced inflation of the dorsal surface immediately in front of it hides much of the margin from above.

From segment 5 to near the caudal end of the body the posterior portion of the anterior subsegments is longitudinally marked with channels nearly twice as long as wide, each usually containing a rounded or oval pit behind; channels separated from each other by a thin, raised ridge. On the anterior poriferous segments the lat-

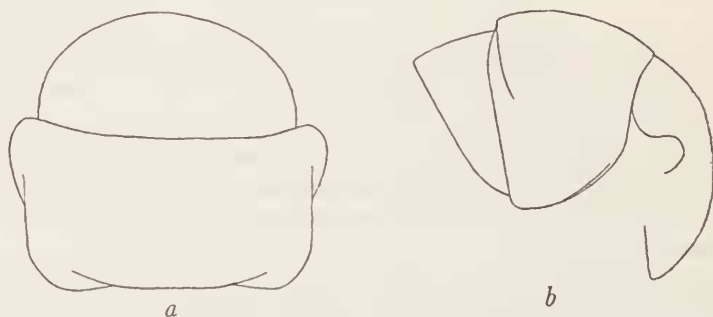


FIGURE 17.—*Odachurus petasatus*, new genus and species: *a*, Head and segment 1, dorsal view; *b*, head and first two segments, lateral view.

eral carinae are rounded swellings, but toward the middle of the body, although low and not abruptly raised from the surface, they become more definite in outline, being distinctly obovate yet not reaching the back margin, as they do on several of the caudal segments, where they project beyond the margin as acute teeth. Antepenultimate segment with the two large dorsal ridges reduced in size but strongly projecting beyond the back margin as teeth. Penultimate segment less than half as long as the foregoing segment and without dorsal ridges or lateral carinae.

Last segment nearly as long as the three preceding segments together, the thickened tip angularly rounded, projecting a little beyond the valves and with two small apical setae. Preanal scale at least four times broader than long; hind margin straight, front margin rounded; process on each side inconspicuous.

Family CAMBALOPSIDAE

The members of this family differ most fundamentally from those of the Cambalidae in the possession of an undivided mentum. The family has hitherto been known only from southeastern Asia, but the discovery of four new species in California greatly extends the distribution, no forms being known as yet from the intervening countries. Two new genera have been required for the inclusion of these species in the classification system, the genus *Endere* having eyes, recessed mandibular stipes, and very strongly constricted neck segments, in contrast to the genus *Leiodere*, with its lack of eyes, convex mandibular stipes, and much less strongly constricted neck segments, to mention only a few diagnostic points.

ENDERE, new genus

Type.—*Endere disora*, new species, from California.

Description.—Body slender, about 18 times as long as broad; distinctly moniliform and a little depressed, as seen in cross section.

Head with ocelli in a single series covered by the anterior margin of segment 1. Antennae (fig. 18, *a*) short, subclavate, broadly separated, inserted on the sides of the head rather than on the dorso-lateral surface, the bases not exposed from above (fig. 18, *b*). Clypeus with six setae. Labrum depressed below the level of the clypeus, tridentate, with sixteen short setae across base. Gnathochilarium (fig. 18, *c*) with mentum entire, nearly as long as the stipes, the upper fourth decidedly attenuated and reaching to near the tips of the lingual laminae, median surface with a rounded depression deepening behind; stipes without a distinct outer angle, the sides continuous, broadly and evenly rounded from the outer papillate process to the base; lingual laminae slender, about half as long as the stipes. Mandibular stipes inconspicuous beneath the lateral margin of the head, the surface distinctly depressed to receive the antennae; lower margin with a raised rim.

Segment 1 broad and longer than the next three segments combined; anterior corners prominent, produced forward, broadly rounded; posterior corners nearly right-angled, produced backward slightly and strongly curved under the body; lateral margin descending obliquely from in front to just behind the middle, where it bends upward, forming an obtuse rounded angle, margin with a faint rim; lateral surface without striations. Head and first five segments shown in lateral view in figure 18, *d*.

Segments 2, 3, and 4 flattened, scarcely convex, lacking the transverse constrictions of the succeeding segments, the sides rapidly

converging backward to the hind margin of segment 4, which is only two-thirds as wide as the widest part of segment 1; ensuing segments abruptly larger. First six segments shown in dorsal view in figure 18, *e*.

From segment 5 to the caudal end of the body the posterior subsegments are conspicuously raised above the anterior subsegments and are more convex, with a low, tumid swelling on each side of the middle and a lateral swelling or prominence bearing the pore (fig. 18, *f*). Pores beginning on segment 5, small and lacking an encircling rim.

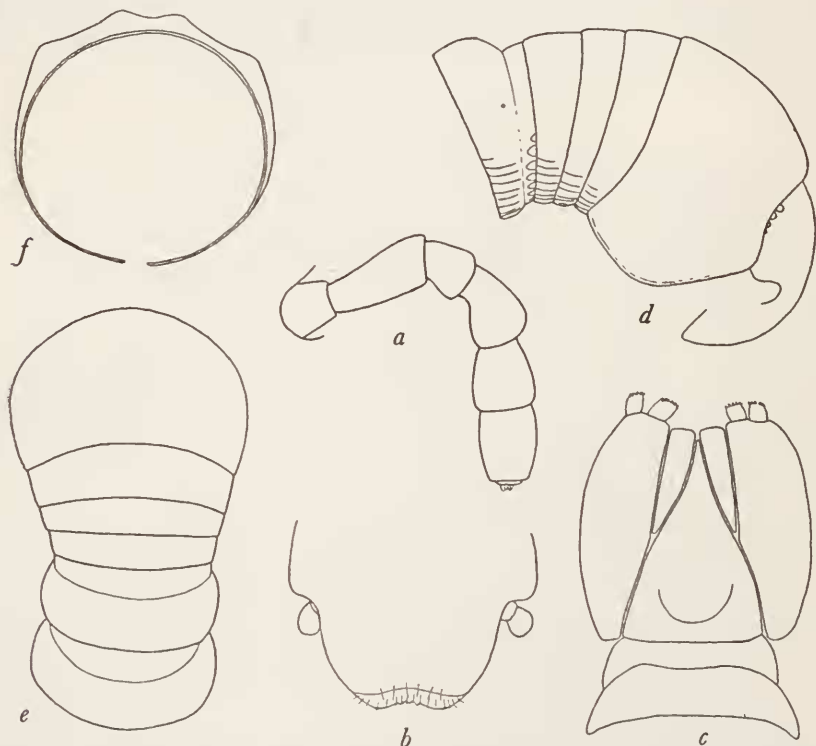


FIGURE 18.—*Endere disora*, new genus and species: *a*, Antenna; *b*, anterior portion of head; *c*, gnathochilarium; *d*, head and first five segments, lateral view; *e*, first six segments from above; *f*, midbody segment, posterior view.

Last segment long, the apex even with the valves; setae of indeterminate number have been rubbed off.

Anal valves moderately inflated and meeting in a broad, deep groove.

Preanal scale a transverse ellipse; the process on each side large.

Males unknown.

ENDERE DISORA, new species

FIGURE 18

A single female specimen collected in an ant nest at Sunnyside Mine, near Seneca, Plumas County, Calif., December 19, 1922, by H. S. Barber. Type: U.S.N.M. no. 1312.

Description.—Body 18 mm long and 1 mm broad; slightly flattened; number of segments, 46. Color of body in alcohol light yellow throughout, indicating that it probably was nearly white in life.

Head smooth and shining; vertex unimpressed; antennae widely separated, the distance between them nearly equal the length of one antenna; antennae rising from beneath the lateral margin of the head, the sockets and most of the first joints hidden from above; joints 1 and 3 subequal in length, shorter than the subequal joints 4 and 5; joint 2 longest, a third longer than joint 6; joint 7 very short, scarcely exposed; joints 4, 5, and 6 of nearly equal diameter; mandibular stipes obscured from above by the sides of the head.

Segment 1 smooth and shining; anterior margin straight and thickened; posterior margin straight across the median part but bending caudad some distance above the hind angles, which are somewhat produced backward.

From segment 5 to the caudal end of the body the segments are strongly constricted at middle; anterior division of each segment moderately convex, with a series of very shallow, indistinct, oblong channels behind, the channels separated by very fine raised lines slightly beaded along their crests; in front of the channels the surface is marked with distinct honeycomb reticulations. Posterior subsegments more elevated, exceedingly convex, without distinct crests but with a broad, tumid swelling on either side of the median line, the swelling gradually raised from in front to the middle; dorsal surface with smaller and less conspicuous reticulations than the anterior subsegment. Pores beginning on segment 5, borne on the anterior slope of a lateral prominence similar to that on each side of the dorsum. Sides longitudinally striate below the pores, especially on the anterior segments. Body narrowing rapidly backward at the last three segments.

Antepenultimate segment slightly longer and a little more convex than the next segment but not so convex as the one before; dorsal elevations not evident, and the pore not on a prominence as on the foregoing segments.

Last segment a little longer than the two preceding segments combined, the apex strongly rounded behind, the setae lost. Preanal scale elliptic and relatively long, being two-fifths as long as broad; the processes that project from under the margin of the last segment and cover the lateral angles of the scale are large and conspicuous.

LEIODERE, new genus

Type.—*Leiodere torreyana*, new species, from southern California.

Description.—Body slender, 15 to 25 times as long as broad, submoniliform; surface smooth, without distinct dorsal ridges.

Head without eyes; antennae rather short and subclavate; clypeus with four large setae; labrum with 14 smaller setae; gnathochilarium with the sides converging toward the base, the mentum entire; mandibular stipes hidden from above, slanting under the head, slightly convex and with a fine raised rim below.

First segment nearly as long as or longer than the next three segments together; with definite anterior and posterior corners, the latter somewhat clasping the sides of the body; lateral margin straight and with a raised rim.

Segments 2, 3, and 4 constricted caudad, forming a more or less distinct neck; dorsum flat longitudinally, not at all convex. Succeeding segments with the posterior subsegment convex, abruptly elevated from the constriction above the anterior subsegment, causing the body to appear submoniliform. In two of the species there is a general swelling of the surface on each side of the middle of the dorsum, with a concomitant median depression; the other species, having no dorsal swelling, lacks the median depression. Pores small, beginning on segment 5, the general surface about the pore slightly more convex than elsewhere, sometimes even raised into a noticeable swelling. Lateral striae not reaching to the pore on any segment.

Last segment as long as or longer than the two preceding segments together; each lateral margin containing a seta and four to eight setae in the apical margin; apex rounded and not projecting beyond the anal valves.

Anal valves moderately convex, the margins meeting in a groove. Preanal scale transversely subelliptic. A process on each side of the scale but not prominent.

First pair of male legs slightly reduced, 6-jointed, the terminal claw normal.

KEY TO THE SPECIES OF LEIODERE

1. Body small, less than 15 mm in length; 40 segments or less; antennae with joint 2 longest..... *nana*, new species
Body 15 mm or more long; segments more than 40; antennae with joint 2 equaled or exceeded by at least one other joint..... 2
2. Dorsum of segments with a shallow median depression, bounded on either side by a broad, indistinct swelling; first segment longer than next three segments combined; last segment with 8 apical setae..... *dasyura*, new species
Dorsum of segments lacking broad swellings or a median depression; first segment shorter than next three segments combined; last segment with 4 apical setae..... *torreyana*, new species

LEIODERE TORREYANA, new species

FIGURE 19; PLATE 2, FIGURES 4, 5

Numerous specimens, including the male type (U.S.N.M. no. 1313), collected at Torrey Pines, La Jolla, Calif., January 11, 1925, by H. G. McKeever and A. D. Harvey. Others collected by Dr. O. F. Cook and H. F. Loomis at the same locality beneath stones on the cliffs above the sea, intermixed with specimens of *Pharodere radiata* and *Odachurus petasatus*, November 26, 1925. Other specimens from 20 miles below Tia Juana, Lower California, January 1925 by Dr. O. F. Cook.

Description.—Body 20 to 26 times as long as broad; a large female 21 mm long, 0.8 mm broad, with 58 segments; another mature specimen has only 43 segments. Color in life dusky cream-white.

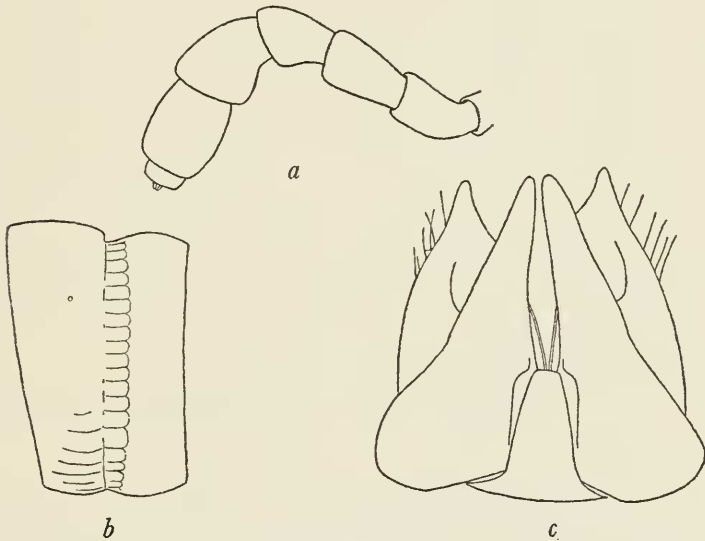


FIGURE 19.—*Leiodere torreyana*, new genus and species: *a*, Antenna; *b*, midbody segment, lateral view; *c*, gonopods, anterior view.

Head eyeless, surface smooth and shining. Antennae (fig. 19, *a*) short and subclavate, separated by a distance equal to over half their length; joints 2, 3, 5, and 6 subequal in length; joint 4 shorter than any except the basal and apical joint, the latter a fifth as long as joint 6; joint 5 widest. Labrum depressed at middle below the level of the clypeus. Mandibular stipes not prominent, slanting slightly inward, the surface faintly convex and coarsely reticulated. Gnathochilarium with sides almost parallel, converging toward the base much less than in the other species.

First segment as long as or a little longer than the next three segments together; anterior edge subemarginate; lateral margin ex-

tending obliquely downward in an almost straight line and with a narrow rim reaching from around the anterior corner to the posterior corner, which is almost a right angle and not conspicuously clasping the side of the body and lacking pronounced striations.

Segments 2, 3, and 4 forming a moderately constricted neck, the posterior margin on segment 4 five-sevenths as wide as the first segment at its broadest part. Segments 2 and 3 flat, without transverse constrictions; segment 4 with a constriction behind which the surface is more convex.

Anterior division of the subsequent segments quite convex; a series of shallow channels along its posterior part, the channels less than twice as long as broad, smooth within, separated by fine, raised, beaded lines; anterior part of subsegment coarsely reticulated; posterior subsegment abruptly raised from the constriction considerably higher than the anterior subsegment, strongly convex; dorsal surface appearing smooth and shining but with correct magnification and lighting numerous short, irregular, impressed lines appear, which, when well developed, form reticulations having meshes longer than broad. A segment from the middle of the body is shown in figure 19, *b*. Pores beginning on segment 5, placed on a very slight swelling high on each side: on the anterior segments the pore is in front of the middle of the subsegment, but farther back it is at the middle. Sides below the pores finely striate longitudinally, the striae of the anterior segments farthest up the sides.

Antepenultimate segment less convex than preceding but more so than the nearly flat penultimate segment.

Last segment longer than the two preceding segments together; posterior margin broadly rounded, with four apical setae and another seta on each side.

Anal valves strongly inflated: margins meeting in a narrow, shallow groove. Preanal scale over three times broader than long; front margin rounded more than the back margin; tab process on either side large.

Gonopods as shown in figure 19, *c*.

Segment 6 of male with pleurae not produced backward; segment 7 with the opening for the gonopods U-shaped, its margin strongly elevated.

LEIODERE NANA, new species

FIGURE 20

Numerous specimens, including the male type, U.S.N.M. no. 1314, were collected between Vallejo and Cordelia, Calif., January 4, 1928, by Dr. O. F. Cook, who also collected a male and two females at Cordelia on February 20, 1929.

Description.—Body long and slender, 9 to 13 mm long and 0.6 to 0.9 mm broad; cylindrical, not at all flattened as seen in cross section; number of segments 32 to 40; living color light grayish white with a series of internal orange spots, the repugnatory glands, showing through the body wall.

Head with the antennae quite short and stout (fig. 20, *a*), arising from the dorsolateral surface, the basal joint almost entirely exposed from above; joint 2 longest; joints 5 and 6 subequal, next in length; joints 3, 4, and 1 decreasing in order named; joint 5 broadest.

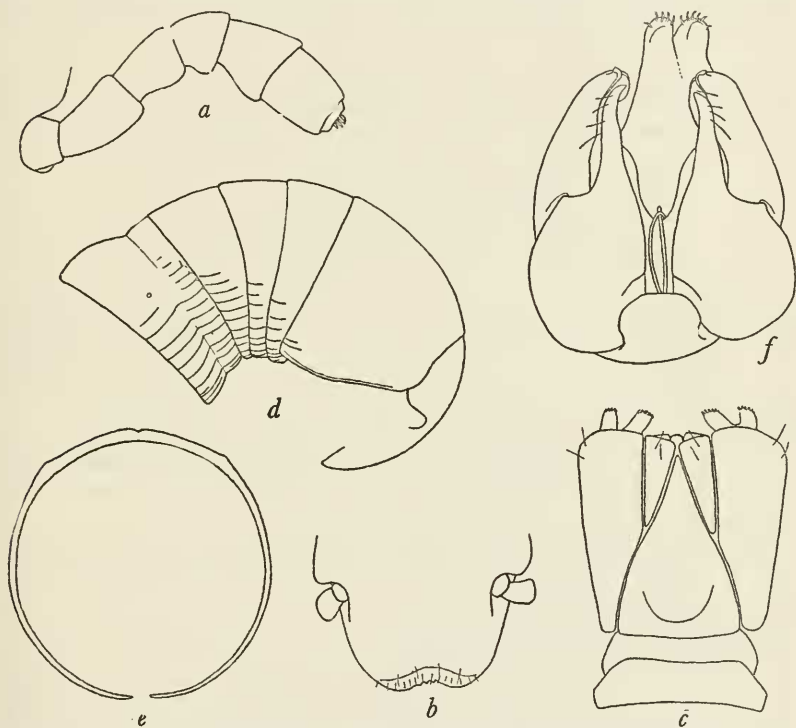


FIGURE 20.—*Letodere nana*, new genus and species: *a*, Antenna; *b*, anterior portion of head; *c*, gnathochilarium of male; *d*, head and first five segments, lateral view; *e*, mid-body segment, posterior view; *f*, gonopods, anterior view.

Clypeus with two setae on each side. Labrum almost continuous with the clypeus, scarcely depressed, with 14 setae across the base. Anterior portion of head shown in figure 20, *b*. Gnathochilarium as shown in figure 20, *c*.

First segment little longer than the next two segments together; the anterior corners broader than a right angle and slightly produced forward; lateral margin obliquely descending to near the hind angle, where it is bent horizontally, the margin with a raised rim; posterior corners square, slightly curved under the side of the body,

two short rudimentary striae sometimes present in the angle; back margin straight throughout its length. Anterior segments shown in lateral view in figure 20, *d*.

Segments 2, 3, and 4 flat, without transverse constrictions; sides slightly narrowing backward, the posterior margin of segment 4 about ten-thirteenths as wide as the widest part of segment 1; lateral striae reaching higher on segments 4 and 5 than on any other segment.

From segment 5 to the antepenultimate segment strong transverse constrictions are present; anterior subsegments moderately convex, with coarse reticulations in front sometimes showing through the semitransparent posterior subsegments, and with shallow rectangular channels behind, twice as long as broad and separated by fine, raised, and very inconspicuously beaded lines. Posterior subsegments with fine median sulcus, more impressed on the back half; surface shining and with many tiny impressed longitudinal lines except on the extremely faint lateral swelling where a considerable area around the pore is dull and conspicuously reticulated. Posterior view of a segment from near the middle of the body is shown in figure 20, *e*. Pores beginning on segment 5, borne on the anterior slope of the faint swelling, the pore minute, without an encircling rim. Penultimate segment much shorter and less convex than the preceding segment, the anterior subsegment exposed only on the sides.

Last segment as long as the two preceding segments together; the apex rather narrowly rounded and exceeded by the anal valves, with four apical setae but none on the side margins.

Anal valves moderately inflated, meeting rather abruptly in a narrow, shallow groove. Preanal scale less than half as long as broad; processes relatively large.

Gonopods as shown in figure 20, *f*.

First male legs reduced in size but with fully developed claws. Other pregenital legs without special modifications.

Genital segments prominent below; the back margins of the broad, overlapping pleurae of segment 6 continuous with the back margin elsewhere, not produced caudad; opening in segment 7 biarcuate behind, the surrounding margin strongly raised.

LEIODERE DASYURA, new species

FIGURE 21; PLATE 2, FIGURE 2

Several specimens, including the male type (U.S.N.M. no. 1315), collected at Tajiguas, Calif., January 1, 1928, by Dr. O. F. Cook, who also collected a male east of San Lucas, Calif., December 20, 1930

Description.—Body slender, 15 to 18 mm long and 0.8 to 1 mm broad; females a little stouter than the males; body cylindrical, com-